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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/536,706	01/03/2006	Stewart E. Hooper	YAMAP0983US	9271

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EXAMINER	
MALEKZADEH, SEYED MASOUD	
ART UNIT	PAPER NUMBER
1791	

NOTIFICATION DATE	DELIVERY MODE
07/09/2008	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

Office Action Summary	Application No.	Applicant(s)	
	10/536,706	HOOPER ET AL.	
	Examiner	Art Unit	
	SEYED M. MALEKZADEH	1791	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *02 April 2008*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-6 and 8-20* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-6 and 8-20* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Response to Amendment

Claims 1-6 and 8-20 are pending.

Claims 7 and 21-23 are cancelled.

In view of the amendment, filed on 04/02/2008, following rejections are withdrawn from the previous office action, mailed on 01/04/2008, for the reason of record.

- Rejection of claims 22-23 under 35 U.S.C. 112, second paragraph
- Rejection of claims 21-22 under 35 U.S.C. 102(b) as being anticipated by Keller et al. (US 5,891,790)
- Rejection of claims 1-6, 8-12, and 23 under 35 U.S.C. 103 (a) as being unpatentable over Keller et al (US 5,891,790)
- Rejection of claims 13-18 under 35 U.S.C. 103(a) as being unpatentable over Keller et al (US 5,891,790) in view of Barnes et al. (US 2004/0214412)
- Rejection of claims 19 and 20 under 35 U.S.C. 103(a) as being unpatentable over Keller et al (US 5,891,790) in view of Hooper et al. (US 2002/0117103)

New Ground of Rejection

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

The factual inquiries set forth in *Graham* **v.** *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

Claims 1- 6 and 8-18 are rejected under 35 U.S.C. 103(a) as being unpatentable over Barnes et al (US 2004/0214412) in view of Van Suchtelen et al (US 4,916,089)

Barnes et al ('412) teaches a method of growing a P-type nitride semiconductor material having magnesium as a p-type dopant by molecular beam epitaxy (MBE), comprising supplying ammonia gas, gallium and magnesium to an MBE growth chamber containing a substrate so as to grow a p-type nitride semiconductor material over the substrate. (See abstract)

Furthermore, the prior art teaches the grown nitride layer is a p-type GaN layer; however, it is not limited to the growth of p-type GaN layer. (See

paragraph [0032]) Moreover, in one embodiment, Barnes et al ('412) teaches the first grown layer is a p-typed doped GaN layer and one or more other (Al,Ga,In)N layers would be grown after the completion step of growing the p-type doped GaN layer. (See paragraph [0052]) therefore, prior art clearly teaches the process of producing a p-type (Ga, Al) N by the MBE process.

Furthermore, Barnes et al ('412) discloses during the epitaxial growth process, ammonia or another nitrogen precursor is supplied to the MBE chamber by means of a supply conduit providing gallium and, possibly, indium and/or aluminium and/or a dopant species from the appropriate sources into the MBE chamber. (See paragraph [0005])

Moreover, the prior art discloses Magnesium is supplied to the growth chamber at a beam equivalent pressure of at least $1\times10^{-9}mbar$, and preferably in the range from $1\times10^{-9}mbar$ to $1\times10^{-7}mbar$ during the growth process. This provides p-type GaN that has a high concentration of free charge carriers and eliminates the need to activate the magnesium dopant atoms by annealing or irradiating the material. Therefore, as to claims 13-16, Barnes et al ('412) clearly teaches supplying magnesium source at a beam equivalent pressure of $1\times10^{-9}mbar$

Furthermore, prior art teaches supplying magnesium at a beam equivalent pressure of $1\times10^{-7}mbar$ would result in a high rate of consumption for the magnesium source material. However, it is preferable to supply the magnesium at a beam equivalent pressure significantly below $1\times10^{-7}mbar$, to

reduce the consumption of magnesium source material. (See paragraph [0044]) Therefore, the prior art teaches changing the supply rate of magnesium during the growth of the nitride layer.

Moreover, Barnes et al ('412) discloses gallium for the MBE growth process is supplied by a beam of elemental gallium having a beam equivalent pressure in the range of $1\times10^{-8}mbar$ to$1\times10^{-5}mbar$. Therefore, as to claims 17-18, Barnes et al ('412) teach supplying elemental gallium at a beam equivalent pressure of at least $1\times10^{-8}mbar$ or below $1\times10^{-5}mbar$.

Furthermore, Barnes et al ('412) teach the substrate is heated to a desired temperature for MBE growth. The substrate temperature during the growth process is preferably at least 850° C. and at the most 1050° C (See paragraph [0035]). However, the prior art is silent about the temperature which growth process is carried out, but it would have been obvious that the substrate temperature is a function of the growth process temperature and therefore, as to claims 8-12, prior art discloses the growth process is carried out at a temperature of at least 800° C and at the most 1050° C which reads on temperature 960° C and below.

However, the prior art fails to teach that the magnesium source which is supplied to the process chamber is bis (cyclopentadienyl) magnesium (CP_2Mg).

In the analogous art, Van Suchtelen et al (US 4,916,089) teach a process for the epitaxial production of semiconductor stock material provided with a layer, wherein a number of metered gases are passed into a MBE (molecular

beam epitaxy) reactor in which the pressure inside of the reactor is brought to a value of ≤ about 10^{-6} mbar and molecular beams are directed onto the heated substrates. (See lines 29-35, column 8)

Furthermore, Van Suchtelen et al ('089) teach supplying (CP_2Mg), as Mg p-type dopant source into the MBE growth chamber for the growth of III-V semiconductors such as GaAs, etc. (See lines 64-68, column 6 and lines 1-12, column 7)

Therefore, it would have been obvious for one ordinary skill in the art at the time of applicant's invention to modify the teachings of Barnes et al ('412) by providing bis (cyclopentadienyl) magnesium (CP_2Mg) because bis(cyclopentadienyl)magnesium (CP_2Mg) has a capability of complete dissociation in the MBE chamber for P-type doping of the semiconductor layer in the MBE chamber, as suggested by Van Suchtelen et al ('089).

Claims 19-20 are rejected under 35 U.S.C. 103(a) as being unpatentable over combined teachings of Barnes et al ('412) in view of Van Suchtelen et al ('089), as applied to claims 1- 6 and 8-18, and further in view of Hooper et al. (US 2002/0117103)

Combined teachings of Barnes et al ('412) and Van Suchtelen et al ('089)teach all the process limitations of a method for growing a P-type nitride semiconductor material as discussed above in rejection of claims 1- 6 and 8-18. Furthermore, Indium and Aluminum have a functional equivalency as a

dopant for the GaN layer in the production (Al,Ga,In)N layers. As discussed above, Barnes et al ('412) teaches gallium for the MBE growth process is supplied by a beam of elemental gallium having a beam equivalent pressure in the range of $1\times10^{-8}mbar$ to$1\times10^{-5}mbar$. However, the combined teachings of Barnes et al ('412) and Van Suchtelen et al ('089) fail to teach the degree of overall beam equivalent pressure supplying gallium and aluminum is between at least $1\times10^{-8}mbar$ to $1\times10^{-5}mbar$ or below.

In the analogous art, Hooper et al (2002/0117103) teaches a method of growing an (In, Ga)N layer structure by molecular beam epitaxy. Hooper et al ('103) further teaches the beam equivalent pressure of indium and gallium supplied to the growth chamber may be equal to or greater than $1\times10^{-8}mbar$ and less than $1\times10^{-4}mbar$. (See paragraphs [0027] and [0028])

It would have been obvious to one of ordinary skill in the art at the time of applicant's invention to modify the combined teachings of Barnes et al ('412) and Van Suchtelen et al ('089) by providing a supplying pressure of more than $1\times10^{-8}mbar$ for gallium and aluminum during (Ga,Al)N growth process in order to prevent from low growth rate of nitride layer and obtaining a high-quality growth of the layers, as suggested by Hooper et al. ('103).

Response to Arguments

Applicant's arguments with respect to claims 1-20 have been considered but are moot in view of the new ground(s) of rejection.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Seyed Masoud Malekzadeh whose telephone number is 571-272-6215. The examiner can normally be reached on Monday – Friday at 8:30 am – 5:00 pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Steven P. Griffin, can be reached on (571) 272-1189. The fax number for the organization where this application or proceeding is assigned is 571-272-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published application may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance form a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/S. M. M./

Examiner, Art Unit 1791

/Philip C Tucker/

Supervisory Patent Examiner, Art Unit 1791